

Masami MIZUSHIMA*: A preliminary revision of the genus
Sagina of Japan and its adjacent regions. 1 (Critical studies
on Japanese plants 5)**

水島正美*: 日本及び近隣地域のツメクサ属 1 (日本植物寸評 5)**

The areas dealt with in this study embrace the temperate eastern Asia, viz. easterly the Japanese Islands, the Bonins, the Ryukyus, Formosa, the Kuriles, and Saghalien; and towards the west, the Korean Archipelago, China including Manchuria and Tibet, and northern India including the Himalayan range. Within these boundaries, species of *Sagina* have been reported approximately 170 years since, and have long been confused being referred to *S. procumbens*, *S. Linnaei*, or *S. maxima*. So far as my present knowledge concerns, there are 4 species indigenous to these regions, viz. *S. japonica* (Sw.) Ohwi, *S. maxima* A. Gray, *S. saginoides* (L.) Karsten, and *S. intermedia* Fenzl, while *S. apetala* Arduino appears to be a casual in northern India and apparently so in Japan. *S. procumbens* was recorded by me from north Honshu of Japan in 1954 as an introduced plant, but it seems to belong to a slightly aberrant form of the species as will be stated below. In India *S. saginoides*, *S. japonica* and even *S. apetala* have been utterly confused with *S. procumbens* since the publication of J. D. Hooker's Flora of British India in 1874, although Hooker himself has realized the difference between *S. procumbens* and *S. Linnaei* (i. e. *S. saginoides*) as proved by the label attached to his collection from India. It is also clear in the vast Chinese territory that *S. japonica*, *S. maxima*, and *S. saginoides* have not been correctly interpreted up to the present.

As to the variation of characters, perennial or annual seems to serve as a good key character in European and sometimes in N. American plants, but it is apparently not the case of E. Asiatic *S. japonica* and *S. maxima*. For instance *S. saginoides* is very often keyed out by the presence of central tuft of leaves, but this characteristic is not workable upon the two plants just mentioned above as follows. The presence or absence of the rosette leaves is ascribed to the individual character in these species. In areas without heavy snowfall in winter, they flower all the year round and propagate freely by means of seeds. After bearing the fruit the mother plant usually die, and new rosettes develop from seedlings. When it is in

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** Contribution no. 1 from Makino Herbarium of Tokyo Metropolitan University.

autumn, young plants winter in this stage of development, but in spring they advance to yield flowering branches during the milder seasons and then disseminate. The rosettes, therefore, are seen in every season accompanying often cleistogamic flowers even in winter in a sunny spot. The phenomenon is thus true in warmer areas and the plant is considered to be annual there. When precipitation is heavy in colder seasons, the rosettes are believed to be protected by the snow covering from the cold. Although rare in my present knowledge, the perennial habit of inland *S. japonica* and littoral *S. maxima* may presumably be caused for this reason on the one hand, and possibly by warm climatic conditions on the other. It may be of ecologically interest that a normally annual plant becomes sometimes perennial in oceanic Japan and on the continental highlands of southwestern China, but the character is often difficult to recognize in a dried herbarium specimen.

In *S. saginoides*, *S. intermedia*, and *S. procumbens*, leaves are perfectly glabrous like pedicels and sepals in the specimens examined, while in *S. japonica* and *S. maxima* these parts are usually glandular-pilose. In f. *crassicaulis* (*S. crassicaulis* Wats.) of the last species, however, a whole plant is glabrous. In *S. apetala*, leaves are ciliate with nonglandular hairs towards the base, and the tip of leaves varies from acute to aristate. In *S. japonica* and *S. maxima* leaves are generally mucronulate at the top with a short point much shorter than a half of the width of blade, whereas *S. apetala* has an arista more than a half of the width. *S. saginoides* and *S. procumbens* are intermediate in this respect in having a mucronate tip with a point at most as long as a half of the leaf-width.

The pedicel recurved near the top after anthesis is a good characteristic in *S. saginoides* and *S. procumbens*, while it is straight or slightly bent at the tip in *S. japonica*, *S. maxima*, *S. intermedia*, and in *S. apetala*.

The genus has been divided into two groups based on the tetramery or pentamery of the flower. *Sagina* in Linnaeus' original sense is doubtlessly construed to contain tetramerous plants, for example *S. procumbens*, *S. apetala*, etc., whereas pentamerous plants, *S. saginoides*, *S. subulata* (not E. Asiatic) for instance, have been segregated from *Sagina* and held in *Spergula*, *Phaloe*, or *Spergella* by old authors. Pentamerous *S. saginoides* has sometimes tetramerous flowers in one and the same individual especially in the Himalayas, and *S. intermedia* bears often tetramerous flowers but pentamerous ones are not rarely found according to individuals or even in the same tuft of branches. In *S. japonica* and *S. maxima* is very rarely found a tetramerous flower; and in this case there are no instances in

my knowledge bearing singly this type of flower.

The shape, size, and the width of scarious margin of sepals vary considerably in 6 species dealt with. The dorsal side of sepals is tinged or fringed with dark purple in *S. intermedia* and rarely so in *S. saginoides* and *S. maxima*. The hooded apex is relatively prominent in *S. saginoides*, *S. intermedia*, *S. apetalá*, and *S. procumbens*, but is scarcely so in *S. japonica* and *S. maxima*. In fruit the midrib becomes prominent in the lower half of the sepal in *S. saginoides*, sometimes in *S. procumbens* and *S. japonica*. In *S. apetalá* and *S. intermedia* the midrib is hardly visible.

The variation in the shape, the size and even the number of petals and stamens is more remarkable. This is partly due to a difficulty of recognizing accurately whether the flower is chasmogamic or cleistogamic in dried specimens. Contrary to the specific epithet, tiny petals often occur in *S. apetalá*. *S. japonica* and *S. maxima* have, in chasmogamic flowers, well developed petals elliptical to nearly rounded in shape and more than 2/3 of sepals in length. Because of their long flowering period, petals are not left alone from the fluctuation in number, shape and size under a variety of climatic conditions in a year. This is also true in the case of *S. saginoides* at least on Sino-Himalayan highlands. The androecium usually consists of 4 stamens, which are opposite to

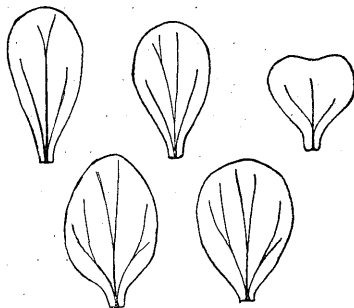


Fig 1. Variation of petals in Himalayan *S. saginoides*. $\times 10$

sepals, in tetramerous *S. apetalá* and *S. procumbens*. While it is normally 10 in pentamerous *S. saginoides*, and 10 or 8 in penta- and tetramerous *S. intermedia*. The number of stamens appears to be more constant in these species than in *S. japonica* and *S. maxima*. In the latter two species stamens are theoretically 10, but usually fewer (5-9) and mixed with one or more staminodes of a various stature or some are completely suppressed even in chasmogamic flowers. The similar variation has been known in *S. procumbens* having more than 4 stamens including staminodes.

The gynaecium is of 4 or 5 carpels, and the number corresponds to the number of sepals 4 or 5. In one exceptional case, however, I observed the flower which has abnormally 6 sepals and 5 carpels in *S. japonica*. F.R.E. Wright reported in Scottish *S. saginoides* having 4 styles or 6 carpels (Journ. Bot. **76**, Suppl. 5,

1938). The ovary has an axial placenta which becomes in fruit a free central one. In 6 species under consideration the variation in the size of flowers and fruits is so great that some forms have been segregated as varieties or forms. From my view point such variations must be of interest in floral biology. Since gynodioecism is known to occur commonly in Alsinoideae of Caryophyllaceae, the variation of the size of flowers and fruits is at least partly attributed to this phenomenon. Yet I have not succeeded to realise the distinct sexual differentiation in flower from the outer-morphology. In fact, although the size of anthers and the length of filaments appear to be nearly constant, the number varies much especially in *S. japonica* and *S. maxima* as mentioned already; and the proportion of capsule to the calyx independently fluctuates 1-1.5 or more in *S. saginoides*, *S. japonica*, and *S. maxima*. I also failed to find flowers showing any trace of degeneration in pistils.

The capsule is dehiscent into 4 or 5 membranaceous to chartaceous valves. The texture of valves appears to depend on the light intensity and/or water supply at the place where an individual plant grows, accordingly this does not serve taxonomically. The seed is deltoid to reniform with a brittle testa smooth to papillose. Among the Eurasiatic species, *S. japonica* has the thinnest testa and is the only one having a papillose seed. The dorsal groove remains up to maturity

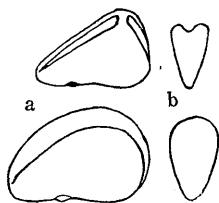


Fig. 2. Schematic representation of two types of seed. a: grooved (upper) and flattish (lower) seeds, seen obliquely. b: their transverse section. $\times 50$.

in *S. apetala*, *S. procumbens*, *S. intermedia*, and *S. saginoides*. In *S. japonica* and *S. maxima* it is true only before maturity. Here is a case worthy to note: *S. oxysepala* Boiss. (1867) is an annual plant belonging to the tetramerous group, and has dimorphic seeds according to individuals, viz. smoothish seeds as in *S. apetala* on the one hand, and on the other the testa is scabrous mainly on the back. It is not sure to me whether this dimorphism is stable or not because of the scanty specimens. A close examination based on a larger amount of material is needed. This Armenian

species is overlooked by Schischkin & Avetisyan during their course of preparation of the genus *Sagina* for Flora Armenii 2 (1956).

Through the data stated above, it is said that *Sagina* is rather difficult to classify from the outermorphology because of their close resemblance and the obscurity of a common and stable diagnostic character. Consequently the tetramery or

pentamery of the flower seems to be insufficient to divide the genus into subgenera or sections, but it deserves at most the serial ranking so far as the Eurasiatic species are concerned. Although the subdivision proposed by Moss (Cambr. Brit. Fl. 3: 24, 1920) appears to be more natural, it is restricted to the British representatives only. Accordingly it can not necessarily be applied even to the whole Eurasiatic species. The chromosome study embraces at present only 1/3 of the species described for the world and confined to those of the north temperate to boreal regions, and the basic numbers are judged to be 6, 9, and 11. From the cytotaxonomic basis, it is clear that the genus is involved in a complex structure. Therefore at present it is sound to keep the subdivision of the genus consisting of about 30 species, and to follow the general usage distinguishing two groups based upon the number of floral organs.

To the directors and curators of the following herbaria, I am glad to take this opportunity to express my gratitude for the loan of their material: Herbarium of Forest Research Institute, Dehra Dun, U. P., India; Laboratoire de Phanerogamie, Museum National d'Histoire Naturelle, Paris, Republ. Franc.; the Herbarium of Harvard University, Cambridge, Mass., U. S. A.; Herbarium of U. S. National Museum, Washington, D. C., U. S. A.; Herbarium of National Museum of Canada, Ottawa, Canada. To Dr. Y. Satake and Mr. S. Okuyama of the National Science Museum in Tokyo, I am deeply indebted for their generosity to place the H. Koizumi collection at my disposal; and to Prof. H. Hara of the University of Tokyo, the head of the Laboratory of Systematic Botany and my teacher, my deep appreciation is hereby expressed for his critical suggestions. (to be continued.)

日本産ツメクサ属の再検に伴い、東亜温帯産のものをなるべく広く調べるよう努力した。本域内にはツメクサ、ハマツメクサ（キタノハマツメクサとエゾハマツメクサを含む）、チシマツメクサ、シムシュツメクサ（別名ヒメツメクサ）が自生し、イトツメクサとアライトツメクサ（この名には些か疑問があり、トヨハラツメクサと称すべきかもしれない）とが帰化品として見られる。現在の邦内にはシムシュツメクサ以外の5種を認めることが出来る。本属を東亜温帯に初めて報じたのは Thunberg (1784) であろうが、彼を始め多数の学者により学名と実物との間に混乱があつた。

まず上記6種に就いて外部形態の変化と其の幅とを知るべく注意し、其の梗概を第1報として報告する。現在ツメクサ属には世界に30種以上を記録されているが、詳細な研究は北半球の特に北部のものによく行われているのみである。其の結果ある程度の形態的地域的まとまりを有する群は「種」として認められ、総体的に microspecies の集

合となつてゐる。これ等の持つ各特徴を東亜温帯産の種類に就いて検討すると、著しく変化して外形的には連続することが多い。その一部は環境条件の変化に伴うものと十分考えられるので、ある程度共通した良い特徴というものも見出し難い。唯欧亜大陸産の種類の中、東亜特産のツメクサと北米大陸太平洋岸に共通するハマツメクサのみ種子背面が無溝であり、ヨーロッパのみあるいは東方へ広布する種類では有溝なのが面白い点と思う。今日まで花部の4数性と5数性とを基として、習慣的に属を2分して来た。これはある程度当るのであるが、5数性のチシマツメクサには時折4数の花が見られ、4数性のアライトツメクサでも5数を示すことがある。シムシュツメクサに至つては4乃至5数で、前者の場合が多いらしいが不安定である。染色体数も6, 9, 11というような基本数を想定出来、寒帯には高次の倍数体と目される種類もあるが、その外形的規制には困難がある。なお軽微ながら性分化があるに相違ないが、それに就いては従来多くを知られてはいないようである。花は虫媒であると同時に豊富な閉鎖花による自花受粉も行われ、他種類との交雑も決して稀ではないらしい。

大凡以上の事が錯綜して個体の表現型を成し、しかも分布には人為の影響も多いと信じられる為、分布圏と形態分化とを純自然的な産物としては扱い難い。これを要するに、形態的にも細胞的にも不安定状態に在り、分類困難の群に数え得るのではあるまいか？ 然しこの度は習慣に従つて属内を2列に区分する立場を取つて置く。外部形態、染色体の両面を併せ考えれば、欧亜産の種類で集合種あるいは上種といったまとまりを掴めぬではないが、これは熱帯及び南半球から記載されたものの詳細も判明した暁の仕事とすべきであらう。

(つづく)

○高等植物分布資料 (14) Materials for the distribution of vascular plants in Japan (14)

○イナベアザミ *Cirsium Magofukui* Kitam. 本種は伊勢員弁(イナベ)郡治田(ハツタ)村の治田山(石灰岩地)で1933年に採集され、北村教授により翌年発表された。以降25年間他所に産するとの報告を知らない。然し井波一雄氏は治田山のすぐ北の藤原村多志田谷(石灰岩地)で1959年の秋に見出されたという。ところが此の稀品が信州上伊那郡伊那里村小瀬戸(約500mの地)に産するのを知った。同郡高遠町在住の柄山祐希(カラヤマユウキ)氏が1957年10月8日に採られたものである。小瀬戸谷は粘板岩脈の上に石灰岩脈が走り、その上をロームが薄く被い、谷の床部を石灰岩塊と粘板岩の砂礫が埋めているという。イナベアザミはそのような場所に生えていたらしい。此の点は伊勢の産地と軌を一にし、残存分子的な感がある。本品の腊葉は頭花の大きさや総苞の概形に於てサワアザミやモリアザミに類するが、総苞葉の縁に小刺を列生する点で断然異なる。邦産アザミ属の中で此の形質は本種特有のものとされておる故、他の形質で余程違うのでない限りイナベアザミとして良いであらう。鳥居喜一氏が言われる遠州水窪(ミサクボ)町長尾〜瀬戸野にて採集の一品もこれではないかと思える。

末筆ながら御教示を仰いだ杉本順一、大村敏朗、井波一雄、鳥居喜一の諸氏に御礼申し上げます。(東京都立大学理学部、牧野標本館、水島正美)